REPORT OF ACTIVITIES
2006 TURTLE ECOLOGY RESEARCH REPORT
Crescent Lake National Wildlife Refuge
1 May to 5 July 2006

A report submitted to Project Coordinator Steve Knode and Refuge Manager Neil Powers
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PURPOSE: To continue studies of the natural history and population biology of the yellow mud turtle, the snapping turtle, the painted turtle, and the ornate box turtle on the Crescent Lake National Wildlife Refuge, and the spiny softshell turtle in Blue Creek on the Peterson Ranch near Oshkosh.

METHODS: Techniques were basically the same as those used in previous years, with both the Main Gimlet (900 meters) and Dike Road (200 meters) drift fences in operation throughout the study period. Fyke nets were employed to capture softshells. Three Earlham undergraduate students and one Miami University graduate student assisted me with the field work.

RESULTS:

Mud turtles

This was a year of weather extremes which greatly affected turtle activity. For the 36 years for which we have good climate data for the Refuge Headquarters area, combined rainfall for April and May was only 1.73", the lowest amount in 36 years, and only 35% of the long-term normal of 4.98". The previous lowest rainfall was 2.08" in 1992. In addition, mean daily temperature for April and May this year was 56.2 F, the highest mean in 36 years, and well above the 36-year mean of 51.4 F. The previous record warmest April and May was in 1977 with a mean of 54.9 F. In addition, the mean May-June temperature was the warmest in 36 years, and the March-June degree days (over 60F) was also the highest over that period.

The general climate over the 36 years has changed significantly. Mean monthly <u>minimum</u> temperatures for each month of the year have increased significantly (statistically), but only the mean <u>maximum</u> monthly temperatures for January have done the same. Thus, the depths of winter have warmed, and nighttime temperatures have increased, whereas daytime temperatures have not changed. Thus, the primary impact of global warming on the area has apparently been to reduce radiational cooling at night and in the winter. It is my subjective opinion that the nights are less clear than in the past (fewer stars visible), so perhaps nighttime clouds and haze are keeping the nights warmer by radiating the earth's heat back to land. It will be very interesting to follow these patterns over the next decade, both on the Refuge and globally.

This year we made 1952 total captures of mud turtles, including 548 hatchlings (203 at the Dike fence, 119 at the Willows section of the Main fence, and 226 at the Gimlet portion of the main fence), and 120 newly marked turtles (most being juveniles that emerged from hibernation in 2001-2005 before our arrival in May or June those years). Since the study began in 1981, we have marked a total of 4884 mud turtles and accumulated 22130 total captures. Virtually all marked turtles less than 36 years of age are now accurately aged.

The warmer spring temperatures this year affected the timing of nesting in yellow mud turtles by advancing it significantly. The first fully gravid females began moving up to nest on 26 May (compared to the long-term average first departure of 7 June. The median date of nesting this year was 11 June, compared to the long-term median of 19 June (and the late median of 24 June last year).

Except for the spring of 2005, the last six years have been drier than normal at the Refuge. One effect of this has been a reduction in the proportion of females that nest each year. No female mud turtles in this population produce more than one clutch per year, but many females actually skip reproduction in some years. As illustrated in Table 1, the number of nesting females has been down significantly in recent years even though the total number of adult females in the population has not declined.

Table 1. Numbers of gravid females captured at various sections of our drift fences.

Year	Dike fence	Main fence (Gimlet section)	Main fence (Willows section)	Total
1998	116	147	89	352
1999	130	141	72	343
2000	153	166	94	413
2004	89	150	46	285
2005	70	139	32	241
2006	81	121	52	254

The dry conditions this year in May also had a significant effect on the pattern of emergence of juvenile mud turtles from hibernation. That emergence requires both warming temperatures and rainfall (to reduce the risk of desiccation during the migration from the overwintering sites on the sandhills to the water in Gimlet Lake). May was extremely dry this year, and the heaviest rain of the month (only 0.33”) fell on the night of 22 May. The following day we captured 461 mud turtles (329 of them hatchlings) and 19 (of only 63 total; see below) box turtles at our fences!! This was the most mud turtles ever captured at the fence in a single day, and reflects how reliant these turtles are on rain in May.

Table 2. Numbers of hatchlings captured at all drift fences by year (for full May-June census years only).

Year	Number of hatchlings

1990	335
1993	7
1994	0
1998	728
1999	554
2006	548

There has been considerable variation over the years in the number of hatchlings encountered at the fences (Table 2). In springtimes following cold summers (e.g., 1993 and 1994) there was almost no recruitment because the ground temperatures in the previous summer were not warm enough to allow that summer's eggs to hatch before winter (and the embryos died in their eggs). In warm summers, hatching success is greatly improved, and with warming winters there is presumably less over-winter mortality. The result is that despite the recent extremes and changes in climate, the Gimlet Lake mud turtle population is thriving, with good representation of all age classes. In addition, based on estimations of ages for adult females in the first year of the study (1981) that are still alive this year, many females in the population must be at least 45 years of age.

Finally, we attached a Tidbit temperature logger to the shell of two male mud turtles in order to record their body temperatures for the rest of the summer and over the coming winter. We will remove and download those data when these males emerge from hibernation next April and are captured at our drift fences.

Snapping turtles

We attempted to capture as many nesting snappers as possible this year, although this work was secondary to our mud turtle work. Nesting season for snappers was also earlier than usual because of the warm spring. Snappers nested from 1 to 11 June this year, whereas the long term average for the commencement of nesting at Gimlet is 8 June. We checked clutch sizes in 24 nests at Gimlet and Island Lakes, and they ranged from 26 to 66 (mean 43.2 eggs). These clutch size numbers are slightly lower than those in recent years (e.g., in 2000, clutch size ranged from 37 to 76 and averaged 55.9 eggs; in 2005, 12 to 76, mean 49.6), perhaps related to the recent lower lake levels associated with the persistent drought.

Painted turtles

We monitored the painted turtle nesting season intensively this year, seeking to mark and protect as many nests as possible for over-winter monitoring. We captured a total of 44 individual turtles a total of 60 times, including 14 young adult females previously unmarked. One recaptured female (#9) has been a regular nester for us since 1981 when she was first marked as an adult (179 mm carapace length; only 12 mm longer this year after 24 years). She is now at least 36 years old. Between 1981 and 1993 her first or second clutches included 16 or 17 eggs; in 2006 her first and second clutches were 16 and 14 eggs, suggesting no significant change in clutch size over the 25 year study. In addition, mean egg mass for her clutches from 1981 to

1993 was 6.7 grams, and it was 6.3 grams for her two clutches in 2006, again suggesting no major change in egg size over the 25 year period.

In the 1990's nesting in painted turtles typically began between 21 and 25 May, and females generally had time during the nesting season for many to produce 3 clutches. But nesting began on 5 June in 2004, a record late 20 June in 2005, and a more normal 31 May in 2006. This year 16 females were able to produce two clutches 14-23 days apart (mean 16.7). We expected nesting to commence early this year, given the warm spring, but we believe that the delays we have seen in recent years are a result of the heavy raccoon predation in at least 2004 and 2005. Larger and older female painted turtles tend to begin nesting earlier in the season, and it was those females that raccoons targeted (based on the female carcasses we found on land). Once snappers began nesting in early June, raccoons switched from feeding on adult painted turtles to eating snapper eggs, but not until they nearly eliminated our old, large adult female painteds. Female #9 mentioned above is one of the few adult females remaining from the 1980s.

As a result of the heavy raccoon predation in 2004 and 2005, a record low number of females nested last year (only 34), of which 18 were young females (ca. 6 to 9 years of age) that were previously unmarked, presumably because they had just reached maturity and were nesting for the first time. This burst in the number of newly maturing females continued this year with 14 more young unmarked females (of the total number of 44) also coming up to nest. We believe that this sharp increase in young females is related to our nest protecting activity in the late 1990's; hatchlings from those nests are now reaching maturity. Had we not protected those nests, the painted turtle population in Gimlet would be dangerously low.

Normally we have no trouble locating and securing 50 painted turtle nests for monitoring through the winter and into the following spring (e.g., 53 in 2004). Last year we located only 31 nests, despite the most intense monitoring of the Refuge housing area in our history. But with active (though not intense) monitoring this year we located 47 nests. We are cautiously hopeful that the level of nesting by painted turtles at Gimlet will rise next year, with the recruitment of even more young females into the nesting population . However, we remain concerned about the recent unprecedented increase in the raccoon population. We removed one lactating female last year (see last year's report), and we were told that five raccoons were live-trapped and relocated off the Refuge earlier this year. Continued presence of a large raccoon population could jeopardize at least the painted turtle population in Gimlet Lake.

We outfitted each of 23 painted turtle nests with a miniature temperature logger to record nest temperatures through incubation and through the coming winter. We plan to return during the last week of March next spring to locate and excavate all nests to determine survivorship. As in the past we will also be studying stamina in the surviving hatchlings. Live hatchlings will then be released into Gimlet Lake.

A sample of eggs from females trapped off-Refuge was also carried back to the Cryobiology laboratory at Miami University (Ohio) for incubation to hatching. The hatchlings will be maintained in an environmental chamber that will mimic Nebraska temperatures into the winter. These hatchlings will then be used in mid-winter experiments to study the physiology of cold stress. It is our hope ultimately to be able to explain how these hatchling turtles can survive the winter in their nests when the temperatures within them drop to as low as –12° C (ca. 10° F) over the winter.

Ornate box turtles

Because of the hot and dry conditions this year, we captured only 63 individual box turtles a total of 140 times. Of these 44 were recaptures from previous years and 19 were newly marked. We have now marked a total of 481 box turtles (2171 total captures). It is our hope this winter to pull together all of our 26 years of reproductive and growth data on this species, and prepare a manuscript to submit for publication.

Spiny softshell turtles

As time permitted we trapped for softshell turtles in the Blue Creek drainage near the Myron and Kay Peterson ranch (Campstool Cattle Company, NNE of Oshkosh). We initiated trapping on 27 May this year, but apparently the warm spring weather had already driven most of the softshells out of the pond and into the creek. As a result we captured only 5 turtles despite intensive fyke netting (six 50' arrays). All were recaptures from previous years. Despite the low sample sizes we are slowly accumulating some valuable growth data. For example, we have now made 3 recaptures of juvenile female softshells at one year intervals and they grew 22, 24, and 31 mm, respectively (an average rate of about 26 mm or one inch per year). Our smallest gravid female was 314 mm carapace length, and hatchlings measure about 40 mm. These data suggest that females might reach maturity at 10 or 11 years of age. To test this hypothesis we hatched 11 eggs in 2004 and 11 in 2005, implanted each hatchling with a passive integrated transponder (PIT tag), and the Petersons released them into their Pond shortly after hatching. We hope to be able to recapture some of these turtles in the future to establish juvenile growth rates definitively.

Although our capture rates are low, we are slowly but surely collecting a respectable data set on reproduction in this poorly studied species. Our x-ray data confirm that females typically produce two clutches per year, the first in early to mid-June, and the second in late June to early July.

Lizard surveys

We assisted Marlin French in monitoring lizard populations at four sites near the Refuge headquarters. Even though based on quantitative samples at only four sites (plus our field experience), there is no question that both lizard diversity and density are higher in areas with open sand (e.g., in disturbed areas), especially those with abundant yucca.

FUTURE PLANS:

2007: -late March to 15 June [At the end of March JBI and students will return to Refuge for 4 days to check nest survivorship from 2006 nests and to construct the drfit fences. Those students will depart, leaving JBI to monitor the fences until early May when two undergraduate students will join me to assist with fence monitoring. My wife Sheila and one graduate student (probably Tim Muir again) will join us about 1 June to monitor painted turtle nesting]

2008: - late March [JBI and two students to Refuge for 3 days to check nest survivorship from 2007 nests]
- ca. 1 June to 1 July [JBI and one or two students to monitor painted turtle nesting season]

2009: - late March [JBI and two students to Refuge for 3 days to check nest survivorship from 2008 nests]
-Timing of summer field work in 2008 still uncertain